POPULAR
Computing
WEEKLY

19 August 1982 Vol 1 No 19

35p

Alien Attack on ZX81



Space Intruders

Sargon Chess

BBC music

Spectrum case swap

Inside Tree



POPULAR Computing WEEKLY

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Accuracy
Popular Computing Weekly cannot accept any responsibility for any errors in programs we publish although we will always try our best to make sure programs work

This Week



Cover illustration by Tasman Inrax

Editorial

Microcomputers are becoming more sophisticated every year Colour and sound facilities no longer excite the user as once they did They are rapidly being taken for granted

Users are now looking forward to micros with flat screen displays and the ability to up and download telesoftware Video disc interfaces and CP/M operating systems will soon be expected as standard

The next generation of micros are likely to be different in kind to their predecessors No longer will mainframe operators be able to refer sneeringly to micros as "toys"

The Japanese are currently working on a fifth generation supercomputer that they hope will think and speak like a man How long before a fifth generation micro appears on the scene?

E F Schumaker first propounded the theory that "small is beautiful" As far as micro enthusiasts are concerned, small is not merely beautiful, it is also better

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Spectrum delay prompts gift offer

THOSE waiting for a ZX Spectrum can expect to have to wait at least 12 weeks before delivery of their orders

This is the situation described in an open letter released by Clive Sinclair

He explains that the problems have been due to initial production delays and orders far exceeding expectations

Production of the machine is now apparently running smoothly at 5,000 units per week and should rise over the coming months The letter continues "We are confident that our order backlog will be cleared by the end of September "

Sinclair Research will be writing to all of its waiting customers explaining the position and offering them all an immediate refund

Those customers who choose to continue to wait will receive a £10 voucher

The £10 voucher can be used against the cost of a ZX Printer or exchanged for a pack of five rolls of printer paper

Clive Sinclair concludes with hope that the current difficulties will be viewed in the context of Sinclair's successful delivery of more than half a million computers in the last two years



Holding up to seven peripheral cards ... the new Texas box

A new box of tricks

A NEW peripheral expansion box has been launched for the TI99/4A machine by Texas Instruments

The system price £190 is capable of housing up to seven peripheral board-type cards

The unit also has space within it to fit a single 5¼ inch floppy disc drive

The plug-in cards available for use with the unit include a 32K Ram expansion, one parallel two RS232 and modem interfaces, and extended Basic, Pascal and various command module software cards

Two additional disc drives can be connected to the unit



NewBrain ... 500 units per week

Grundy steps up its micro production





THE NewBrain micro from Grundy Business Systems is now in high-volume production following its launch in May

More than 500 units per week are being produced at the special assembly line at Thorn EMI Datatech in Feltham

The plant has the capability to manufacture up to 3,000 micros per week and its automated printed-circuit board component insertion and testing equipment can handle more than 4 million components per month

The announcement of the production figures was made as Information Technology Minister Kenneth Baker opened the new Grundy research and development laboratories at Cambridge

Cut-price Texas micro signals US market war

TEXAS Instruments in the US has lopped £58 off the price of its TI99/4A microcomputer so that is now sells at £115

This makes the machine cheaper than its rival, the Commodore Vic20 which sells for £140 in the US

The move also makes the TI99/4A a direct competitor to the Sinclair Spectrum

However it is not clear when the ZX Spectrum will be launched in America

A spokesman for Sinclair Research said that it was hoped to market the machine there in early 1983

This expectation is dependent on several factors An American launch will not be contemplated until the UK production difficulties are sorted out and demand in the home market has settled down

Even then, if the Spectrum passes the rigorous US product tests, it is not clear if Sinclair will be able to sell the machine there

Under Sinclair Research's far reaching agreement with Timex US the latter has free rein to market Sinclair micros as they are to modify them (as in the case of the TD1000 now being sold which is a 2K version of the ZX81) or to produce an entirely different computer using Sinclair technology

The terms of the agreement allow Sinclair Research's US subsidiary to continue to sell machines only as long as Timex US sales are below a certain threshold level Beyond this level their sale is prohibited

This cut off applys not just to the equivalent micro, but to the whole range

So, if Timex sales of their ZX81 adaptation have exceeded this threshold level, then Sinclair Research will be prohibited from launching the Spectrum in the US

The gospel according to Clive

CLIVE Sinclair predicts that by the end of the century there will be more than 10 million people unemployed in Britain, with only 10 percent of the population employed in manufacturing industries

These remarks formed part of a speech delivered by Sinclair to members of Mensa at their third annual symposium in Cambridge

The qualification for membership of Mensa is a high IQ The most intelligent two per cent of the population are elligible and the group has 60 000 members world wide some 8 000 of whom are UK residents

Sinclair, founder of Sinclair Research, is currently the Chairman of British Mensa

The address he gave at the symposium examined the so-called Golden Ages of mankind The conclusion Sinclair drew was that many of the conditions he identifies as necessary for a Golden Age are developing in our present society

He believes that there is shortly to be a hundred-fold reduction in the cost of data manipulation, which will be coupled with a dramatic decline in the manpower requirements of industry

"I believe" said the Mensa chairman, "that positions in industry are inimical to the human spirit" He continued "A move away from this present type of organisation will restore the potential of the individual"

Such a change would result in a reaffirmation of class distinctions and lead to a revival of traditional artistic and creative patronage

"Early in the next century we will have made intelligent machines, ending for all time the current pattern of drudgery It may well be" he said "that western civilisation is just about to flower "

£50 ZX81

Sinclair have cut the price of their ZX81 by £20 from £69 95 to £49 95 This follows a drop in the price of their 16K Ram pack from £49 95 to £29 95, in April



Letters

write to Letters, Popular Computing Weekly, Hobhouse Court, 19 Whitcomb Street, London WC2

Yes, you too can make the grade

Congratulations to David Lawrence on his excellent renumbering program for the ZX81 (*PCW* July 1). This, along with Nick Hampshire's 3D Spectrum Graphics, was one of the best programs you have ever published.

I felt that those people who have upgraded to a ZX Spectrum should not be left out. So, here are details of how to convert the renumbering program.

Change these lines

```
9998 LET X1=23755
9871 IF PEEK (I+3)=14 THEN GO
     TO 9874
9876 LET BASE=10
9877 LET X1=23755
9990 DIM B$(4) LET B$(5-LEN
     STR$ BASE TO )=STR$ BASE
     FOR J=1 TO 4
9991 POKE (VAL T$(1 TO
     I+4)+J) CODE B$(J)
9993 LET BYTE1=BASE-256*INT
     (BASE/256)
9996 LET BYTE2=INT (BASE/256)
9996 POKE MEMORY+8 BYTE1
9997 POKE MEMORY+9 BYTE2
```

AND delete line 9998.

The program will now run on a standard Spectrum. Also, this version can handle a BASE value of less than four digits. I hope that someone will find these alterations useful.

Bill Longley
368 Ipswich Road
Colchester
Essex

But no one's without fault

I must correct the impression given by Sinclair Research in your letters page of July 8. Their claim not to have sold a faulty ZX81 after July '81 is incorrect. I bought mine in September '81 and it had a faulty Rom.

The unit was replaced, but I now seem to have another problem. This program was written to extract cube roots. It works fine on some numbers, but try inputting 27 or three and then see what happens.

```
10 Input A
20 Input B
30 Let C=((( A/B)/B)+B)/2
40 If C=B THEN GOTO 80
50 Let B=C
60 Goto 30
70 Print
80 Print "Cube root is " C
```

Perhaps some reader with more knowledge of maths than I have will be able to solve the problem.

W McLaren
70 Lyndale Road
Whoberley
Coventry CV5 8AQ

So just show your character

I am writing to point out a useful addition to the program entitled 'Character Plot' in *PCW* July 1, on page 15. Not everyone wishes to feed the new characters directly from tape onto their programs as a series of peeks and pokes. Some people prefer to have the information in data statements.

Add the following line to the program

```
425 FOR K = 1 TO N FOR J = 0 TO
    7 PRINT PRINT A(K,J) NEXT
    NEXT
```

the program will then print out the numerical information necessary to fill a data statement in a program for the new character created. It is best to use the program to compile one new character at a time when doing this, otherwise the string of numbers printed out will extend off the screen. An excellent program this. Very useful. Congratulations to the author.

C Cattanach
11 North Ride
Danesbury Park
Welwyn
Hertfordshire AL6 9RD

And we'll try to show ours

I have taken your magazine since it started and look forward to collecting my copy on Wednesdays. I am pleased to see it is not full of advertisements.

I am a Vic20 user, just started in computing and enter the programs you publish. However, I would say that the printing of your programs leaves a lot to be desired. Would it be possible to improve them by darker printing? As you are aware, it only needs one letter to be unreadable and the program will not run.

E Mowlem
6 Leedam Road
Bournemouth
Dorset BH10 6HP

Otherwise it's really not fair

I have a regular order for your magazine placed with my newsagent. Up until now I have generally been very satisfied with it. But your issue of July 15 disappointed me a great deal.

Being a Vic20 owner, I was delighted to see the number of programs included for my machine. However, having struggled to type in 'Spy Hunt' and having almost ruined my sight to decipher 'Vic' (an excellent program it turned out to be), I found it totally impossible to do anything with 'Hangman' and 'Anagram Birds'. Would it be possible to send me a listing of these programs, particularly 'Anagram Birds'?

I am pleased to see a greater leaning towards educational uses as I have two children for whom these would be extremely useful — hence my delight with 'Vic'.

Before finishing, would it be possible to warn any would-be purchasers of Tim Hartnell's *Symphony for a Melancholy Computer* to think again? It is so full of errors that the Office of Fair Trading might do well to consider whether it is fit for the purpose for which it is intended.

Jim Corrigan
23 Brook Avenue
Uppermill
Oldham
Lancashire 0L3 6DR

We have received a number of letters complaining about the quality of our Vic listings (*PCW* July 22). These criticisms are justified, particularly in regard to our July 15 issue.

As we have already explained, all our programs are reproduced directly from the original listings so as to minimise the number of errors. Vic printer listings seem to reproduce very badly. However, by choosing darker listings wherever possible and by reproducing them as large as possible, we are solving the problem. The Vic listings in *PCW* July 29 and August 5 are a substantial improvement.

We will be happy to supply you with a copy of 'Anagram Birds', but I am afraid we have no other copies of 'Hangman'.

And the answer is a lemon!

I ordered my BBC micro in December and after the customary wait received it in 'average' condition. Not quite dead on arrival, as many have been, but the keyboard had fallen out. This problem sorted out, I soon found strange faults with the machine that proved to be caused by overheating.

On being informed of a local agent, I duly took them my micro on April 26. It was nearly two weeks before they even looked at it. They informed me it had been sent back to Acorn.

On June 11 my micro was returned absolutely untouched — nothing had been done to it, it still overheated. On June 14, I returned it to the agent. I am still waiting.

To all those who had a long wait or are waiting now — should your BBC micro go wrong you too could be like me waiting three months for your micro to be returned. You will also receive a card guaranteeing your micro for six months — will my guarantee run out before my micro is returned?

What with defective ULA's, the provisional user guide, an operating system that does not follow the specification and a failure rate (at my computer club anyway) of around 50 per cent, I think the BBC and Acorn should christen the BBC micro, as I have done, *'The Lemon'*.

I also suggest the people I keep phoning at the Repair Centre should be called the *Lemonades*.

P Webb
30 Walpole Road
Runcorn
Cheshire

COVER STORY

Alien Attack

A 1K machine code game for ZX81 by Jeff Naylor

Anyone with a Sinclair ZX81 without some form of memory expansion will admit that although moving graphical games are possible in Basic, they rarely satisfy avid arcade machine players with either their speed or complexity. The addition of more memory allows complex games, but those graphics are still slow to the point of boredom.

Machine code, on the other hand, by talking directly to your computer's microprocessor, speeds things up to the extent that delay loops are needed to give us humans a chance. I have written a machine code game that imitates the original Space Invaders arcade machine which has given so many people pleasure, ground-down teeth, and a shortage of loose change.

This 1K version still has limitations, no shields to hide under, and the score not appearing until the end, for example. The invaders do speed up as their numbers reduce and, if you manage to wipe them all out, another bunch appears twice as fast as before. The game can also be tailored to your own level of skill, with overall speed, the number of aliens and the speed of their firing all easily adjusted.

One problem with machine code programs is how boring they are to enter, another is that mistakes can creep in at any stage, and when that happens debugging them is no laughing matter. My listing consists of two columns — one in hexidecimal, the other in decimal, so as to provide a cross-reference.

You have the choice as to which to load — decimal is easier if you don't know your way round a keyboard too well, while it is good practice and a bit quicker, once you have got the hang of it, to use the hexidecimal codes.

I make no attempt to explain the nuts and bolts of the program. If you do not understand machine code I recommend the book *Mastering Machine Code on your ZX81* by Toni Baker. The program was developed with no knowledge other than that gained from the book.

The basic ZX81 has less than 900 free bytes of Ram, and to fill a screen would use 729 bytes, so the program uses alternate lines of the screen except at the top and bottom. This gives the impression of using the whole screen, but uses only 409 bytes.

The Sinclair graphics allow only a rough approximation to the original game, and those symbols used are chosen with care — only invaders or explosions can have odd character codes, and everything on the bottom line must have a second hex digit of 6 — ie inverse A has a hex character code of A6, you can look up the others in the back of the Sinclair manual.

To load the program first enter *Fast* as a command, as the first part is very tedious indeed. Enter the first line as 1 REM (347 zeros).

The 347 zeros are reserving space for the machine code. Don't bother counting the zeros exactly until you have entered ten lines (32 zeros per whole line) but enter the remaining 27 with care, as you are on the limits of memory, and will have difficulty getting into the *Edit* mode if you make a mistake.

Having typed the *Rem* statement, press *Newline* then return to the slow mode. It is probably worth saving on tape — just in case. Now enter the loading program. Listing 1 is for decimal, Listing 2 for hex. These will poke the required machine code commands into line 1.

Run the program, and in response to the first input prompt, enter 16514 as the starting address. Using decimal, enter only one code at a time, starting with the decimal code for 16514. Using hex you may enter up to eight codes before pressing *Newline*. If you enter more you will probably get a 4 error code, don't panic, just enter *Cont* as a command. If you find you have gone astray, break out by entering any single letter other than 'A' and rerun the program, starting at an address you know to be correctly loaded.

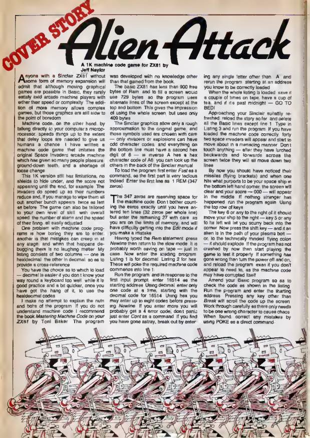
When the whole listing is loaded, save it a couple of times on tape, have a cup of tea, and if it's past midnight — GO TO BED!

Approaching your Sinclair suitably refreshed, reload the story so far, and delete all the Basic lines except line 1. Type in Listing 3 and run the program. If you have loaded the machine code correctly, forty two space invaders will appear and start to move about in a menacing manner. Don't touch anything — after they have lurched backwards and forwards across the screen twice they will all move down two lines.

By now you should have noticed their missiles (flying brackets) and when one hits what purports to be your space ship in the bottom left hand corner, the screen will clear and your score — 000 — will appear in the middle. If nothing stranger has happened, run the program again. Using the top row of keys.

The key 6 or any to the right of it should move your ship to the right — key 5 or any to its left will let you scurry back into the corner. Now press the shift key — and if an alien is in the path of your plasma bolt — or, to the technically minded, flying colon — it should explode. If the program has not crashed by now then start playing the game to test it properly. If something has gone wrong then turn the power off and on, and reload the program, even if you don't appear to need to, as the machine code may have corrupted itself.

Amend your Basic program so as to check the code as shown in the listing. Run the program and enter the starting address. Pressing any key other than *Break* will scroll the code up the screen. Work through carefully as there only needs to be one wrong character to cause chaos. When found, correct any mistakes by using POKE as a direct command.



ADDRESS	HEX	DEC
16514	06	6
	3B	59
	3E	62
	1B	27
	D7	215
	10	16
16520	FF	255
	06	6
	0A	10
	C5	197
	3E	62
	76	118
	D7	215
	D7	215
	06	6
	20	32
16530	FB	251
	A5	165
	10	16
	FC	252
	E1	225
	1A	26
	CA	202
	04	4
	20	32
	3E	62
16540	16	22
	D7	215
	10	16
	FB	251
	2A	42
	0C	12
	40	64
	11	17
	76	118
	01	1
16550	19	25
	22	34
	3C	60
	40	64
16554	22	34
	3E	62
	40	64
	23	35
	00	0
	06	6
16560	22	34
	40	64
	40	64
	18	24
	08	8
	2A	42
	1C	28
	40	64
	11	17
	3E	62
16570	00	0
	4B	75
	06	6
	02	2
	C5	197
	06	6

ADDRESS	HEX	DEC
	06	6
	1E	30
	05	5
	2E	46
16580	8B	139
	19	25
	10	16
	FB	251
	1E	30
	04	4
	19	25
	C1	193
	12	18
	F0	240
16590	2A	42
	54	84
	40	64
	2B	43
16594	7C	124
	85	133
	20	32
	FB	251
	2B	43
	3C	60
16600	40	64
	43	67
	16	22
	77	119
	23	35
	77	119
	23	35
	73	115
	3A	58
	23	35
16610	54	84
	FE	254
	F7	247
	20	32
	0B	11
	3E	62
	2B	43
	2B	43
	7E	126
	FE	254
16620	16	22
	28	40
	22	34
	25	37
	1E	30
	0D	13
	FE	254
	E4	228
	1E	30
	07	7
16630	23	35
	7F	127
	FE	254
	16	22
16634	3C	60
	01	1
	2B	43
	2B	43
	2A	42
16639	2A	42

ADDRESS	HEX	DEC
	1B	27
16640	3C	60
	58	88
	36	54
	08	8
	23	35
	36	54
	A8	168
	23	35
	36	54
	80	128
16650	3E	62
	42	66
	44	68
	2B	43
	0E	14
	82	130
	3C	60
	1B	27
	CB	203
	CB	203
16660	26	38
	47	71
	3C	60
	04	4
	CB	203
	6C	108
	1A	26
	44	68
	CB	203
	79	121
16670	21	33
	22	34
	2B	43
	28	40
16676	54	84
	23	35
	23	35
	CB	203
	F8	248
	22	34
16686	07	7
	36	54
	00	0
	11	17
	22	34
	00	0
	93	147
	ED	237
	5C	92
	3E	62
16696	1B	27
	BE	190
	1E	30
	0C	12
	97	151
	BE	190
	30	48
	06	6
	36	54
	17	23
16706	18	24

ADDRESS	HEX	DEC
	06	6
	2E	46
	12	18
	22	34
	03	3
	21	33
	00	0
	00	0
	22	34
16716	58	88
	40	64
	2A	42
	3E	62
16720	58	88
	2B	43
	B2	178
	CB	203
	47	71
	28	40
16726	E6	230
	FE	254
	1B	27
	25	37
	1B	27
	CB	203
	64	100
	04	4
	2A	42
	28	40
16736	42	66
	C9	201
	75	117
	21	33
	08	8
	21	33
	55	85
	00	0
	CB	203
	1E	30
16746	C2	194
	85	133
	60	96
	CB	203
	B0	176
	24	36
	EA	234
	FE	254
	1D	29
	25	37
16756	05	5
	0C	12
	36	54
	00	0
16760	22	34
	21	33
	36	54
	00	0
	C8	200
	C8	200
16766	CB	203
	60	96

ADDRESS	HEX	DEC
	0A	10
	CB	203
	3C	60
	28	40
	07	7
	23	35
	3A	58
16776	1E	30
	2A	42
	0C	12
	11	17
	48	72
	08	8
	19	25
	7E	126
	E6	230
	0F	15
	FE	254
	06	6
	1F	31
	05	5
	56	86
	C9	201
	36	54
	8B	139
	22	34
16790	3E	62
	40	64
	21	33
	21	33
16798	56	86
	34	52
	CB	203
	46	70
	21	33
	3A	58
16800	2A	42
	46	70
	40	64
	C3	195
	74	116
	21	33
	01	1
	5F	95
	20	32
	40	64
16810	82	130
	FE	254
	82	130
	28	40
	06	6
	9C	156
	17	23
	3E	62
	20	32
	27	39
16820	00	0
	11	17
	22	34
	00	0
	19	25

ADDRESS	HEX	DEC
	FE	254
	82	130
	3C	60
	0F	15
16830	FE	254
	22	34
	28	40
	0F	15
16834	FE	254
	00	0
	28	40
	0B	11
	FE	254
	17	23
16840	28	40
	08	8
	3E	62
	3E	62

ADDRESS	HEX	DEC
	1B	27
	C5	195
	28	40
	02	2
	50	80
	C9	201
16850	21	33
	00	0
	00	0
	36	54
	10	16
	22	34
	4E	78
	58	88
	C3	195
	CE	206
16860	36	54

LISTING 1

```
10 PRINT "1ST ADDRESS?"
20 INPUT A
30 PRINT AT 15,0,A;" "        (there is a space between the quotes)
40 INPUT X
50 POKE A,X
60 PRINT PEEK A
70 LET A=A+1
80 SCROLL
90 IF A>16866 THEN STOP
100 GOTO 30
```

A Basic program to load machine code in decimal. To modify it to check data already entered delete Line 40 and replace Line 50 with

```
50 IF INKEY$="" THEN GOTO 50   (no space between quotes)
```

LISTING 2

```
10 PRINT "1ST ADDRESS?"
20 INPUT A
25 LET X$=""                   (no space between quotes)
30 PRINT AT 15,0,A;" "         (space between quotes)
40 IF X$="" THEN INPUT X$      (no space between quotes)
50 POKE A,16*CODE X$+CODE X$(2)-476
60 PRINT CHR$ INT (PEEK A/16+28);CHR$
   (PEEK A- INT (PEEK A/16)*16+28)
70 LET A=A+1
75 LET X$=X$(3 TO)
80 SCROLL
90 IF A>16866 THEN STOP
100 GOTO 30
```

Listing 1 modified to load hexadecimal data. To use for checking delete Lines 25, 40 and 75 and change Line 50 as shown in Listing 1

LISTING 3

```
10 LET A = USR 16514
20 CLS
30 PRINT AT 10,15;A;"00"
```

The driving program to run the machine code. You may prefer to make

```
15 PAUSE 200
```

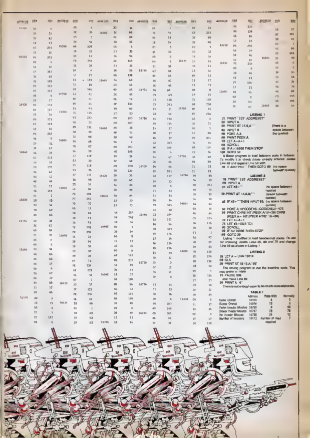
and make Line 30

```
30 PRINT A;"0"
```

There is not enough room to be much more elaborate.

TABLE 1

	Address	Poke With	Normally
Faster Overall	16586	4	8
Slower Overall	16646	10	6
Faster Invader Missiles	16799	6	56
Slower Invader Missiles	16797	78	78
No Invader Missiles	16798	24	32
Number of Invaders	16673	Number of rows required	7



Out for the count and seeing stars!

David Nowotnik shows school children how to add and subtract.

The first hurdle in learning elementary arithmetic is teaching the child to count. Once children have learnt to count, they can associate the number with its character on the keyboard. The numbers one to nine presented no great problem as they are one-digit numbers which appear in order on the top row of the keyboard. Two-digit numbers presented a little more difficulty. The following short routine was of assistance:

```
10 PRINT"          COUNT"
20 FOR I=1 TO 12
30 PRINT
40 PRINT I TAB 4
50 FOR J=1 TO I
60 PRINT "*",
70 NEXT J
80 IF INKEY$="" THEN GOTO 80
90 NEXT I
```

The child can count the stars in each line and, with practice, associate the number at the beginning of the line with the number counted. Figure 1 contains a more complex version of this program.

In 'Count', the number of stars is selected at random. No number is given, and the child is expected to add up the stars and enter the correct total. When the child gives his answer, the computer counts the stars, one-by-one, to check if the child was right. Seeing the computer counting helps the child to get it right.

The next stumbling block in arithmetic is subtraction. The way this is put across to the child will vary from school to school. My youngster learnt it as 'the difference between ...'. The program he used to conquer this concept is listed in Figure 2.

Two numbers between one and 20 are selected at random. These numbers are shown in two ways, as the number, and as a string of stars. The idea is to recognise that the difference between the two numbers is the sum of the stars which do not overlap.

If the child gets the answer wrong, the stars which do overlap are converted to inverse video to reinforce the idea that those parts of the two rows are the same. The difference is now more clearly marked, and the child is asked to try again.

Fig 1

```
10 RAND
20 PRINT AT 1,1;"CAN YOU COUNT?"
30 LET R=INT (RND*15+5
40 PRINT AT 5,4;
50 FOR I=1 TO R
60 PRINT "*"
70 NEXT I
80 PRINT AT 1,2;"HOW MANY DOTS ARE THERE?"
90 INPUT A
100 PRINT AT 14,1;"YOUR ANSWER WAS ";A;". IS IT RIGHT?"
104 FOR I=1 TO 30
106 NEXT I
110 FOR I=1 TO R
120 PRINT AT 5,4+I;" "
130 FOR J=1 TO 10
140 NEXT J
150 PRINT AT 4,4+R-1;"*";AT 8,5;I
160 FOR J=1 TO 25
170 NEXT J
180 NEXT I
190 IF A<>R THEN GOTO 250
200 PRINT AT 16,1;"YOU WERE RIGHT"
210 GOTO 290
250 PRINT AT 16,1;"THE RIGHT ANSWER WAS ";R
280 FOR I=1 TO 200
290 NEXT I
300 CLS
340 GOTO 20
```

Fig 2

```
10 RAND
20 PRINT AT 1,1;"THE DIFFERENCE BETWEEN. ......."
30 LET R=INT (RND*20+1
40 LET S=INT (RND*20+1)
50 PRINT AT 6,0;R;AT 8,5;
60 GOSUB 200
70 PRINT AT 8,0;"AND"
80 PRINT AT 10,1;S;AT 10,5;
90 GOSUB 250
100 PRINT AT 14,2;"WHAT IS THE DIFFERENCE?"
110 INPUT A
120 IF A=ABS(R-S)THEN GOTO150
125 PRINT AT 18,5;"TRY AGAIN"
130 LET B=R*(R<S)+S*(S<R)
132 FOR I=1 TO B
135 PRINT AT 6,4+I;"*";AT 10,4+I;"*"
140 NEXT I
145 GOTO 110
150 PRINT AT 18,4;"THATS RIGHT"
160 FOR I=1 TO 50
170 NEXT I
180 CLS
190 GOTO 20
200 FOR I=1 TO R
210 PRINT "*";
220 NEXT I
230 RETURN
250 FOR I=1 TO S
260 PRINT "*";
270 NEXT I
280 RETURN
```

Street Life

The man who wants to be a millionaire

***David Kelly** talks to Steve Vickers, co-designer of the ZX Spectrum*

Steve Vickers was heavily involved in the design of the ZX Spectrum. He wrote most of the Spectrum's Rom and manual.

But he did not touch a computer until he was 16. His father gave him the first book on Basic written by the two researchers at Dartmouth College who developed the language.

"When I was in primary school," grins Steve, "the only thing I was sure about was that I was going to be a doctor.

"I wanted a PhD — after that I was convinced that I would be free to do whatever I wanted.

"I didn't plan a career in computers. In fact I don't think I planned anything at all. When I left Leeds University after gaining a PhD in mathematics a friend of mine said that micros were the great thing so I wrote round and started applying for jobs."

Steve got involved with Sinclair completely by accident. "I applied to Sinclair and they turned me down — they said they had no vacancies. In the end I got a job working for a software house called Nine Tiles."

It was not until after Steve began working for them that he discovered that Nine Tiles were contracted by Sinclair Research to write all their software and firmware.

When he joined Nine Tiles the ZX80 had just been launched and they were completing work on the ZX81.

In July 1981 Sinclair began planning the Spectrum. In due course Nine Tiles began work on the firmware. With only six people on the staff, Steve was chosen to write the coding.

Sinclair laid down the basic specifications of the new machine. It was to have colour, sound and, to save time, would use essentially the same firmware as the ZX81. The keyboard and cassette interface also needed to be improved.

During the six months that Steve worked on the Spectrum he spent half his time at Sinclairs and half at Nine Tiles.

At Sinclair he worked with Richard Altwasser who designed the Spectrum hardware. "While Richard was building up the hardware I'd be sorting out the software on it," says Vickers.

"King's Parade (Sinclairs) was really the only place where I could test what I was doing.

"In such a small team — Richard and I were the only ones that worked full time on the Spectrum's development — it was easy to sort out any problems.

"Much of the ZX81's firmware was taken over to the Spectrum unmodified. We had to get the machine out quickly so the ZX81 code was altered as little as possible. That is why the Spectrum is comparatively slow — the ZX81 was always designed to save bytes, not time."

Some things seemed to be continuing problems — like the Ink and Paper commands. Each pixel can be paper or ink but, within each character space of 8 x 8 pixels, only two colours can be shown. "In a sense," says Steve, "the Spectrum has hi-res graphics with low-res colour.

"If the Paper and Ink were the same colours in the lower part of the screen (where the cursor is) then it would have been impossible to see what was happening. We eventually decided to make the lower part of the screen the same colour as the border," explains Steve. "It seems silly, but it took a lot of fiddling to get that to work properly."

When the design work was completed in February Steve took a month off from his work at Nine Tiles and wrote the manual that accompanies the Spectrum.

In April this year Steve Vickers left Nine Tiles. Simultaneously Richard Altwasser left Sinclair Research, and the two designers have set up their own company Jupiter Cantab.

Steve is understandably somewhat reticent about their plans. "I left Nine Tiles because I wanted to be my own boss. I saw how many millions Clive Sinclair was making and thought 'Why not us?'

"I had always thought Richard was a good person to work with. He came up with an idea — something no one else has done — and that's what we've been busy working on."

Steve confided: "Now that it is nearly finished, we can hardly stand the tension — I'm on tenterhooks."



Steve Vickers: "I saw how many millions Clive Sinclair was making"

What's happening

Wallington Computer Club has been formed. The group meets on alternate Mondays at 7.30 pm. For more details contact Douglas Mynett, 15 Sandy Lane South, Wallington, Surrey (Tel. 647 2857).

Genius ZX81 Club has been formed to exchange programs and ideas by post. Contact Ayyaz Mehmood, 30 Webber House, North Street, Barking, enclosing a SAE for further information.

Vic-Pet Computer Club meets fortnightly at the Spread Eagle, Oakley Hay, near Corby, Northants at 7.30 pm. Contact P Wilson, 26 North Cape Walk, Corby, Northants (Tel. Great Oakley 742622).

Northwest London Spectrum User Group is soon to be formed. Interested parties should contact Jonathan Briggs, 33 Wessex Gardens, London NW11.

Swindon ZX Users Club has been formed. The club will hold monthly meetings. For more details contact Andrew Bartlett, 47 Grosvenor Road, Swindon, Wilts (Tel. 0793 30770).

Reviews
software

Sargon 11 Chess

Commodore 675 Ajax Avenue Slough Trading Estate Slough Berkshire
Vic20 cartridge
Price £24 95

This cartridge must be one of the best produced, so far from the Commodore stable It follows in the tradition of earlier Sargon games and gives the player an excellent game of chese at all of the different skill levels The response time taken by the computer is also excellent The average reaction time ranges from two seconds upwards

As with all Commodore cartridges, there is a screen alignment function This cartridge also has a screen/character colour change facility which I found an added bonus

The movement of the pieces could not be simpler If you have a joystick then all you do is move a flashing square over the piece which you want to move and press the *Fire* button Then you move the flashing square again If you do not have a joystick you can type in your move in the format A1-A5

The cartridge is accompanied by an eight-page booklet which contains a 'Teach yourself chess section However this section leaves much to be desired if you are a novice at chess

Summary
All in all Sargon II is one of Commodore s best cartridges yet I would recommend it to anybody who likes a good game of chess Even if it is £5 more than any other cartridge it is definitely worth it **TR**

Space Intruders

Quicksilva 92 Northam Road Southampton
ZX Spectrum 16K, cassette.
Price £5 95

There is very little games software for the ZX Spectrum as yet Of that which I have seen this is the best At almost £6 though it seems a little expensive

As the name suggests this is a space invaders type of game If you do not like these games do not bother reading further *Space Intruders* is written in machine code is fast has good graphics reasonable (if quiet) sound effects and is a fairly simple version of the game

It is fun to play with the intruders appearing neither too fast nor too slow at the beginning and then speeding up when only a few intruders are left They approach the base with steadily increasing pace and quite often crash into the base to end the game Scores are high once up to 350 000 but I never managed to get beyond seven attack waves

Apart from the game itself there were several nice touches The best was the H(old) facility which meant that when I had to answer the door the game was stopped exactly where it was I could talk for hours and then carry on with the game from where I had left off by pressing S(tart) Sometimes if I had managed to get as far as the third wave of intruders (not a common happening) pressing H allowed a quick breather before re-entering the battle

Another good feature is the way in which the initials of the person with the highest score are entered

Summary
A good example of the genre with some useful features and a slight touch of humour After the first wave has been vanquished each successive wave has a wobbly mutant intruder (for which you get more points) which until it reverts to normality, looks quite funny wobbling across the screen **BA**

Tasword

Tasman Software 17 Hartley Crescent Leeds LS6 2LL
ZX81 16K cassette
Price £6 50

Tasword is a new word-processing program from Tasman Software This company also publishes a couple of very impressive educational programs which will be evaluated in a forthcoming look at available Sinclair educational software

Impressive is the only word too for the book of documentation that comes with Tasword It is well written and has been printed with the aid of Tasword itself

Side 2 presents a tutorial program It is an eloquent demonstration of Tasword s uses and a great help in exploring the main program s complexities

Having practised the commands available the user can load Side 1, upon completion of which he is presented with a blank page At the bottom is the line number, which at the start is set at 1 A flashing cursor is at top left awaiting your first input

One of the most useful features of Tasword is the full left and right justification This is done automatically as you type so that the keyboard can be given full attention

The Word Wrap facility means that any word that over runs the end of the line is moved down to the next line Thus the *Newline* key is only needed to start a new paragraph The 'Word-Wrap is normally on but it can be keyed off in order to split a word between two lines

This facility together with the automatic justification means that the user would not normally have to look at the screen until the end of each typing session

The cursor can be moved to any position on the screen in order to add text Adding or altering words or symbols destroys the justification but the program will upon command re justify the whole paragraph It s almost worth the price to watch it do this

There are several other commands available while typing in text Whole lines may be moved left and right headings centred and so on

Once the text is complete it can be read by scrolling up or down Also the start or finish may be immediately found

The program allows 320 lines or 14 screens of text This number can be reduced (before typing starts) thus cutting down on subsequent *Saving* and *Loading* time

Tasword contains a *Help* page which can be referred to at any time It lists the functions of all the command keys (*Edit Scroll, Insert*-characters etc)

Summary
Tasword is obviously not going to be any sort of competition for Word Star and the like It does not contain a dictionary against which it can check spellings and it does not have any kind of tabulation But neither does it need several thousand pounds worth of hardware to run it

The program is very good value and great fun to use Tasword will be a boon to anyone who has to prepare articles or notices for their club and so on Unreservedly recommended **TB**

```
HOW TASWORD WORKS

THE TEXT FILE

  TASWORD OPERATES ON A TEXT
FILE WHICH IS 320 LINES LONG.
THIS TEXT FILE CONTAINS WHATEVER
YOU TYPE IN FROM THE KEYBOARD.
(THE SIZE OF THE TEXT FILE CAN
BE CHANGED - SEE PAGE 10). YOUR
TELEVISION IS A WINDOW SHOWING
22 LINES OF THE TEXT FILE.
CERTAIN CONTROL KEYS MOVE THE
WINDOW UP OR DOWN THE TEXT FILE.

THE KEYBOARD

  EACH TIME YOU PRESS A SINGLE
KEY THE CHARACTER ON THAT KEY
APPEARS ON THE SCREEN AT THE
CURSOR POSITION. THE EXCEPTION
IS THE NEWLINE KEY WHICH MOVES
THE CURSOR TO THE BEGINNING OF
THE NEXT LINE.

  CERTAIN CHARACTERS ARE MARKED
IN RED ON THE KEYBOARD. TO TYPE
ONE OF THESE CHARACTERS HOLD THE
SHIFT KEY DOWN WHILE YOU PRESS
THE RELEVANT KEY. ([illegible])

  THE RED MARKINGS ON SOME OF
THE KEYS ARE NOT SINGLE
CHARACTERS BUT ARE WORDS OR
DOUBLE CHARACTERS (EDIT, STOP,
** ETC). THESE ARE THE TASWORD
CONTROL KEYS.
```

Hollywood gets inside the video game

***Brendon Gore** looks behind the scenes of an exciting new film.*

Tron is a Walt Disney film that follows in the trail of other science fiction spectaculars such as *Star Wars, Close Encounters Of The Third Kind* and *Battlestar Galactica* It has opened to considerable acclaim in the US and is due to be released in the UK in October

Set in the not too distant future *Tron* starts out as a conventional thriller Kevin Flynn played by Jeff Bridges is attempting to gain access to information stored in computer data banks at Encom a multinational communications company

Flynn is trying to prove that he wrote a number of highly successful video arcade games while he was employed by Encom. Another Encom employee Ed Dillinger took the credit for inventing the games Dillinger was subsequently promoted to company vice-president

With the help of a fake access code Flynn searches the Encom computer for evidence to back up his claims But the computer's Master Control Program (MCP) is aware of Flynn's activities and cuts off his input When Flynn tries to deprogram the MCP it activates an experimental laser and turns it on him

This is where the film really takes off The laser is a form of matter transmitter which can break down objects into electrical particles and reconstitute them elsewhere

Flynn is translated into another dimension, an electronic world where computer programs have come to life Flynn has become, literally, the player in the machine

This world is ruled by the tyrannical MCP and by Sark Dillinger's alter ego Programs who disagree with the MCP are captured and released in the video games grid an arena where video games are fought to the death

The main opposition to the MCP is provided by Tron a video games warrior played by Bruce Boxleitner Tron is one of the few programs who still believes in the Users, the real world programmers who created them

Tron and Flynn are matched together in the video games grid But using hi-res light-cycles, they manage to escape

With Sark and the MCP's minions in hot pursuit, Tron and Flynn find two allies in Yori and Bit Bit is an electrical pulse who can only answer yes or no depending on whether his charge is positive or negative

The Master Control Program (MCP) is the computer overlord in the new film ***Tron***

Together they link up with an old priest, Dumont who plays a similar role to Obi-wan Kenobi in *Star Wars* Dumont gives Tron an identity disc which can store information or be used as a weapon Thrown like a frisbee the disc heats up and cuts through its victim

Armed with the disc, Tron confronts Sark in a program-to-program duel to the death Sark loses the duel with Tron, but is revived by the MCP But, just when it seems that Sark may be indestructable, Flynn destroys the MCP's power source

As the MCP disintegrates Flynn finds himself back in the real world With access to the Encom computer, Flynn can prove his case

Tron should be a fascinating film that will owe much of its success to the imaginative use of computer graphics Director Stephen Lisberger a long time fan of video games first had the idea for the film in 1978

"We had played all the video games," says Lisberger "And when we investigated computer art, we realised that by combining the concepts of electronic imaging we could bring something to life that had not been there before

Human fights video warriors in ***Tron***

"Everyone's looking for new fantasies in the movies," he says "Outer space has been done to death They have gone inside the body and under the sea

"We have created this world in *Tron* by taking video games and just blowing them out to the point where they are a reality At the point where the games met computer graphics something came alive that had not been alive before Video games were the basis for the fantasy — computer imagery was the means to create it

The computer graphics used in the film were largely created by two US companies, Information International Inc (Triple-I) and Mathematical Applications Group Inc (MAGI)

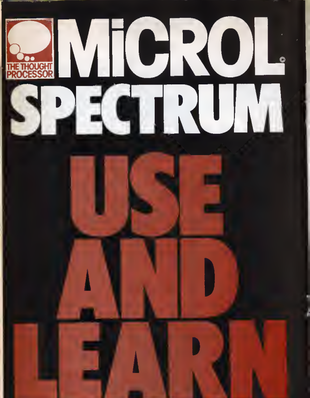
Artists impressions of various objects in the film, such as the hi-res light-cycles, were plotted in three dimensions and fed into a digital computer This enabled the object's movement to be choreographed frame by frame through the film

Each frame on the film contained two million pixels, and each pixel was assigned both colour and intensity values Thus the 24 frames which make up one second of the film contained almost 100 million bits of information

"For objects simulated in a computer there are no laws of physics" says Richard Taylor of Triple-I "Each time you sit down to create a computer image you are setting completely new rules for reality That's what *Tron* is all about

Tron is likely to give rise to a number of spin-offs Bally Manufacturing, the largest producer of video arcade games in the US is currently working on a Tron video game It will be available in the UK later this year or early next year

Given the success of sequels such as *Rocky II* and *III* and *The Empire Strikes Back*, there is a fair chance that *Tron II* will appear on the cinema screen before too long


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Open Forum

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It is important that your programs are bug free before you send them in. We cannot test all of them.
Contributions should be sent to: Popular Computing Weekly, Hobhouse Court, 19 Whitcomb Street, London WC2H 7HF

How to contribute

Each week the editor goes through all the programs that you send to Open Forum in order to find the Program of the Week.

The author of that program will qualify for DOUBLE the usual fee we pay for published programs.

(The usual fee is £10.)

Presentation hints

Programs which are most likely to be considered for the Program of the Week will be computer printed and accompanied by a cassette.

The program will be well documented, the documentation being typed with a double spacing between each line.

The documentation should start with a general description of the program and then give some detail of how the program has been constructed and of its special features.

Listings taken from a ZX Printer should be cut into convenient lengths and carefully stuck down on to white paper, avoiding any creasing.

Please enclose a stamped, self-addressed envelope.

Reection Timer

on Spectrum

Enter the program as listed and Run. The instructions are displayed and you should press any key to proceed.

When you have pressed a key there will be a random delay in which if you press a key a message saying 'do not cheat' will be displayed and you will be asked to press another key to preceed.

When the border colour changes you should press any key as fast as you can and your reaction time will be displayed. If you took longer than .5 seconds then a message 'do not waste my time' will appear, and you will again be asked to press any key to preceed.

If your reaction was not the fastest then the fastest will be displayed with the name of the person who achieved this.

If your reaction was the fastest you are told so and you can enter in your name. When you have done so it will be displayed and you will be asked as to whether you want another go.

Reaction Timer
by Christopher Green

```
  20 RANDOMIZE : LET a$="Christo
pher Green": LET a=.2: PAPER 0:
INK 7: BORDER 0: CLS
  30 GO SUB 160: PRINT AT 5,0;"T
his program tests your reaction"
;TAB 14;"time.",AT 9,1,"When the
 border colour changes press any
 key as fast as you canyour reac
tion time will then be";TAB 14;"
given.";AT 16,3; FLASH 1;" Press
 any key to proceed ": PAUSE 6E+
4: CLS
  40 PAUSE RND*150+100: IF CODE
INKEY$=0 THEN GO TO 60
  50 PRINT PAPER 6; INK 9;AT 20,
10;"Do not cheat": GO TO 30
  60 POKE 23672,0: POKE 23673,0:
BORDER 6: PAUSE 55: LET time=(P
EEK 23672-1)/50
  70 IF time>.5 THEN PRINT PAPER
 6; INK 9;AT 20,6;"Do not waste
my time": GO TO 30
  80 GO SUB 160: PRINT INK 7;AT
5,6,"Your reaction time was";TAB
 10,time;" Seconds": IF time>=a
THEN GO TO 110
  90 LET a=time: INPUT INK 4; FL
ASH 1;" Please enter your name "
',a$
 100 IF a$="" OR LEN a$>31 THEN
GO TO 90
 110 PRINT AT 9,4; INK 4;"The fa
stest reacton was";TAB 10;a;" Se
conds"';TAB 6;"and was achieved
by";TAB INT (16-LEN a$/2);a$;AT
17,2; FLASH 1; INK 9; PAPER 6;"
Do you require another go? ": PR
INT TAB 8; PAPER 6; INK 9; FLASH
 1," Press Y or N ": PAUSE 6E+4
 120 LET b$=INKEY$: IF b$<>"y" A
ND b$<>"n" AND b$<>"N" AND b$<>"
Y" THEN GO TO 110
 140 CLS : IF b$="y" OR b$="Y" T
HEN GO TO 30
 150 BORDER 2: PAPER 1: INK 9: C
LS : PRINT AT 10,6," End of prog
ram ": GO TO 999
 160 BORDER 0: PAINT AT 0,9;"REA
CTION TIMER": PLOT 71,167: DRAW
114,0: PLOT 72,166: DRAW 112,0:
RETURN
```

Super Nova

on Vic 20

This is a space game for the Vic20 It uses user-defined graphics so it will only run on the basic machine

The idea is simple You must avoid the randomly generated asteroids, and missiles and try and run into the two different types of alien You have three lives which can be used up by the asteroids and missiles The game ends either when you have lost all three lives or when you run out of fuel — in which case you win

The spaceship is made up out of four squares and is user-defined The aliens are also user-defined, as are the asteroids and missiles The program takes full advantage of the Vic s sound colour and graphics capabilities

Lines 1 to 8 set up the title and colour
Lines 10 to 60 set up the screen and the variables
Lines 60 to 100 decide which keys move the spaceship
Lines 105 to 108 find out if you have hit anything
Line 108 decides if you have run out of fuel
Lines 104 to 284 output an explosion and deduct a the
Lines 300-400 print the score and end the game
Lines 500 to 504 make sounds to tell you that you are out of fuel
Lines 700 to 740 print the first sort of spaceship
Lines 504 to 1030 tell you if you have hit the first sort of spaceship
Lines 1500 to 1540 print the second spaceship
Lines 1200 to 1730 tell you if you have hit the second spaceship
Lines 1740 to 1748 print missiles
Lines 2000 onwards are data for graphics

There will be a short pause when you run the game while the graphics are set up Control is achieved through the two cursor keys

Super Nova
by Neil Sibley

```
1 PRINT"▓▓▓▓▓▓ PER NOVA" REM BY NEIL SIBLEY (C)1902
2 PRINT"▓▓▓▓HIT A KEY TO START"
3 GETG$ IFA$= "THEN3
5 FOPH=1TO100? NEXTH GOSUB2000
6 POKE36079,8 POKE36069,255
7 H=0 S=0 Z=0 T=0
9 Q=50
10 A=7900 B=1 D 8164
20 FORJ=1TO24 POKE198,0 PRINT NEXT
25 FORK=1TO700
30 POKED+INT(32*RND(1)),2
31 POKE36878,6 POKE36877,130
35 R=INT(25*RND(1))
36 1FR=1THEN700
37 IFR=2THEN1500
38 IFR=3THEN1740
40 FORJ=1TOQ NEXTJ
45 Q=Q-5.125
50 POKEA+B,32 POKEA+B+22,32 POKEA+B+44,32 POKEA+B+66,32
55 PRINT GOTO60
56 PRINT PRINT
60 GETA$
70 IFA$=""THEN100
80 IFB>1ANDA$="▓"THENB=B-1 POKE36877,120 POKE36878,15 FORJ=1TO10 NEXTJ POKE7910+
A+B,32
90 IFB<21ANDA$="▓"THENB=B+1 POKE36877,120 POKE36878,15 FORJ=1TO10 NEXTJ
100 POKEA+B,0 POKEA+B+22,1 POKEA+B+44,6 POKEA+B+66,7
105 IFPEEK((A+B+66+22))=2THENT=T-1 GOTO114
106 IFPEEK((A+B+66+22))=3THEN900
107 IFPEEK((A+B+66+22))=8THEN1600
108 IFPEEK((A+B+66+22))=9THENT=T-1 GOTO114
110 IFK=>660THEN500
112 NEXTK
114 POKE36879 42
115 POKEA+B,4 POKEA+B+22,5 POKEA+B+44,4 POKEA+B+66,5
200 POKE36877,220
210 FORL=15TO0STEP-1
220 POKE36878 L
230 FORM=1TO100
240 NEXTM
250 NEXTL
260 POKE36877 160
270 POKE36878,0
275 POKE36879,8
```

Open Forum

```
277 PRINT "YOU HAVE ",3+T,"LIVE, LEFT" FORS=1TO1000 NEXTS
278 POKE36869,255
279 IFT=-3THEN313
280 GOTO30
300 PRINT"" POKE36869,240 POKE36875,0 PRINT"WELL DONE YOU MANAGED TO LAST OUT"
301 PRINT"UNTIL YOUR FUEL RAN"
302 PRINT"OUT " FORS=1TO2500 NEXTS
313 Z=X POKE36869,240
315 PRINT"YOU SCORED",Z IFT=-3THENPRINT"BEFORE YOU GOT BLOWN" PRINT"UP"
336 PRINT
337 PRINT
338 PRINT
339 PRINT
340 PRINT

400 END
500 L=1 POKE36878,15
501 POKE36877,0 FORS=125TO240 POKE36875,S NEXTS POKE36875,240 FORS=1TO200 NEXTS
502 POKE36875,0 POKE36875,240 FORS=1TO200 NEXTS L=L+1
503 IFL<4THEN501
504 GOTO300
600 T=-3 GOTO114
700 FORP=1TO10
710 POKEB+INT(32*RND(1)),3
720 FORJ=1TOQ NEXTJ
730 POKEP+B,32 POKER+B+22,32 POKER+B+44,32 POKER+B+66,32
740 GOTO55
900 POKE36879,127
920 POKE36877,0
930 POKE36878,15
950 FORS=250TO160STEP-0.5 POKE36876,S NEXTS
970 POKE36876,0
1000 POKE36878,0
1001 POKE36869,255
1010 X=X+INT(500*RND(100))+100
1011 PRINT "",X FORS=1TO1000 NEXTS POKE36869,255
1020 POKE36879,8
1030 GOTO30
242 FORJ=1TOQ NEXTJ
1500 FORP=1TO10
1510 POKEI+INT(32*RND(1)),8
1520 FORJ=1TOQ NEXTJ
1530 POKER+B,32 POKER+B+22,32 POKER+B-44,32 POKER+B+66,32
1540 GOTO55
1600 POKE36879,110
1620 POKE36877,0
1630 POKE36878,15
1650 FORS=160TO250STEP0.5 POKE36876,S NEXTS
1670 POKE36876,0
1700 POKE36878,0
1701 POKE36869,255
1710 X=X+INT(500*RND(100))+100
1711 PRINT"",X FORS=1TO1000 NEXTS POKE36869,255
1722 POKE36879,8
1730 GOTO30
```

Bsttleships

on ZX81

The computer is set into fast mode in line 30 and generates the position of 30 ships, 10 cruisers, 10 frigates and 10 aircraft carriers. These are represented by inverse video symbols of C-F-A and displayed for two seconds to simulate a sonar trace.

Line 330 clears the screen and subroutine 1000 draws a grid. The positions of the ships ers held in the array DIM A(17,29) and the type of craft is known by the value of the subscript — 0 for an empty position, 1 for a cruiser, 2 for a frigate and 3 for a carrier.

B$ holds the co-ordinates for firing the torpedoes and subroutine 3000 compares the co-ordinates with the value of the corresponding subscripts of the array and scores according to the craft hit, if any.

The score is displayed constantly and also the number of torpedoes left.

```
1740 FOR P=1TO10
1741 POKEP+INT(32*RND(1)),9
1743 POKEA+B,32 POKEA+B+22,32 POKEA+B+44,32 POKEA+B+66,32
1744 GOTO56
1745 GOTO114
2000 DATA153,255,153,153,153,219,90,60
2001 DATA60,165,189,219,219,255,126,60
2002 DATA4,44,62,62,60,28,9,0
2003 DATA60,126,171,171,126,60,0,0
2004 DATA57,68,130,11 ,82,92,200,160
2005 DATA234,169,105,128,70,56,0,0
2006 DATA60,60,126,255,219,219,153,153
2007 DATA255,126,126,60,60,24,60,24
2008 DATA126,90,255,189,189,36,66,36
2009 DATA16,56,56,56,56,124,124,214
2010 FORI=0TO511
2014 POKE7168+I,PEEK(32768+I) NEXT
2015 FORI=0TO79 READJ POKE7168+I,J NEXT
2016 RETURN
```

PROGRAM OF THE WEEK

Battleships
by P J Lording

```
10 REM "BATTLESHIPS"
15 GOTO 700
20 DIM A(17,29)
25 LET SCORE=0
30 FAST
40 FOR C=1 TO 10
50 LET B=INT (RND*15)+1
55 LET B=B+37
60 LET A$=CHR$ B
65 LET A=INT (RND*8)+1
70 GOSUB 2000
80 PRINT AT LINE,TAB "■"
90 LET A(LINE,TAB)=1
100 NEXT C
140 FOR C=1 TO 10
150 LET B=INT (RND*15)+1
155 LET B=B+37
160 LET A$=CHR$ B
165 LET A=INT (RND*8)+1
170 GOSUB 2000
180 PRINT AT LINE,TAB "■"
190 LET A(LINE,TAB)=2
200 NEXT C
240 FOR C=1 TO 10
250 LET B=INT (RND*15)+1
255 LET B=B+37
260 LET A$=CHR$ B
265 LET A=INT (RND*8)+1
270 GOSUB 2000
280 PRINT AT LINE,TAB,"■"
290 LET A(LINE,TAB)=3
300 NEXT C
310 SLOW
320 PAUSE 100
330 CLS
335 GOSUB 1000
340 LET T=30
345 PRINT AT 21,15,"SCORE ",SCO
RE
350 INPUT B$
355 GOSUB 3000
360 IF A(LINE,TAB)=1 THEN GOTO
400
370 IF A(LINE,TAB)=2 THEN GOTO
500
375 IF A(LINE,TAB)=3 THEN GOTO
600
380 PRINT AT LINE,TAB,"X"
385 LET T=T-1
390 PRINT AT 20,15,"TORPEDOS LE
FT ",T
394 IF T=0 THEN GOTO 700
396 GOTO 350
400 PRINT AT LINE,TAB,"■"
410 PRINT AT 21,0,"HIT...HIT...
"
420 LET SCORE=SCORE+50
430 PRINT AT 21,15,"SCORE ",SCO
RE
440 LET T=T-1
450 PRINT AT 20,15,"TORPEDOS LE
FT ",T
460 PRINT AT 21,0,"
465 IF T=0 THEN GOTO 700
470 GOTO 350
500 PRINT AT LINE,TAB,"■"
510 PRINT AT 21,0,"HIT...HIT...
520 LET SCORE=SCORE+10
530 PRINT AT 21,15,"SCORE ",SCO
RE
540 LET T=T-1
550 PRINT AT 20,15,"TORPEDOS LE
FT ",T
552 PRINT AT 21,0,"
565 IF T=0 THEN GOTO 700
570 GOTO 350
580 PRINT AT LINE,TAB,"■"
610 PRINT AT 21,0,"HIT...HIT...
620 LET SCORE=SCORE+30
630 PRINT AT 21,15,"SCORE ",SCO
RE
640 LET T=T-1
650 PRINT AT 20,15,"TORPEDOS LE
FT ",T
660 PRINT AT 21,0,"
665 IF T=0 THEN GOTO 700
670 GOTO 350
700 IF INKEY$="" THEN GOTO 700
710 CLS
720 GOTO 10
750 PRINT "BATTLESHIPS BY P.J L
ORDING"
755 PRINT AT 3,0,"THE COMPUTER
WILL PLOT 10 OF"
760 PRINT "EACH SHIP AND DISPLA
Y THEIR"
765 PRINT "POSITIONS FOR 2 SECO
NDS"
770 PRINT
775 PRINT "■ SCORES 30 POINTS"
780 PRINT "■ SCORES 20 POINTS"
785 PRINT "■ SCORES 10 POINTS"
790 PRINT
800 PRINT "YOU HAVE 30 TORPEDOS
ONLY"
810 PRINT
820 PRINT "ENTER THE GRID REFER
ENCE AS ONE"
830 PRINT "LETTER FIRST THEN NU
MBER AND"
840 PRINT "PRESS NEWLINE"
850 PRINT AT 20,0,"PRESS ANY KE
Y WHEN YOU ARE READY"
860 IF INKEY$="" THEN GOTO 860
870 CLS
880 GOTO 20
1000 LET N=1
1010 FOR L=1 TO 17 STEP 2
1020 PRINT AT L,0,N
1030 LET N=N+1
1040 NEXT L
1050 LET CODE=38
1060 FOR T=1 TO 29 STEP 2
1070 PRINT AT 0,T,CHR$ CODE
1080 LET CODE=CODE+1
1090 NEXT T
1095 RETURN
2000 LET NO=1
2010 FOR N=38 TO 52
2020 IF A$=CHR$ N THEN LET TAB=N
O
2030 LET NO=NO+2
2040 NEXT N
2050 LET NO=1
2060 FOR N=1 TO 9
2070 IF A=N THEN LET LINE=NO
2080 LET NO=NO+2
2090 NEXT N
2095 RETURN
3000 LET NO=1
3010 FOR N=38 TO 52
3020 IF B$(1)=CHR$ N THEN LET TA
B=NO
3030 LET NO=NO+2
3040 NEXT N
3050 LET NO=1
3060 FOR N=1 TO 9
3070 IF VAL B$(2)=N THEN LET LIN
E=NO
3080 LET NO=NO+2
3090 NEXT N
3095 RETURN
```

COPY OF THE SCREEN AFTER A GAME

```
 A B C D E F G H I J K L M N O
1
2
3           X X X X X
4           ■ X X X X
5     ■   X ■ X ■ ■ X
6         X X X ■ ■ X
7       X   X X ■ X X
8
9

            TORPEDOS LEFT 0
            SCORE 140
```

Open Forum

Dodge

on BBC Micro

This game is based on a program written for a Vic20 by Stuart Debuse of Bognor Regis. I have modified it considerably in order to run it on a BBC Model A computer, and it now bears little resemblance to his program.

It is all in Teletext mode, as this allows the Model A to use more than four colours.

The object of the game is to survive by dodging the asteroids (apostrophes), for as long as possible whilst hitting as many aliens (asterisks) as one can.

The actual game is called by line 260. Lines 470-540 initialise the variables. B% holds the current position of your ship, represented by a magenta V. Line 490 turns off the auto-repeat. Line 510 sets up a text window the size of the whole screen. If this was omitted, the scrolling would not work as we want it to.

The game, proper, is in lines 550-740. Lines 560-590 prints between 1 and 6 asteroids onto the screen. There is a 1 in 10 chance of an alien being printed on each row, lines 600+610. The game finishes when you have hit 12 asteroids, and the duration of the game is recorded, lines 740+750.

Lines 850-980 define the procedure to handle collision with an asteroid, whilst lines 1000-1150 deal with the collision with an alien. Lines 1170-1240 provide a sonic departure from the game. I have called it PROCtune as an incentive to modification.

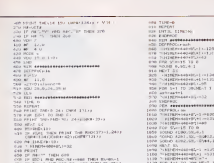
After PROCplay, the screen is cleared and the highest score so far is calculated, lines 270-290. Lines 310-360 provide a report. Lines 410+420 put the cursor keys back to normal. Lines 430+440 provide a test mode, a la The Computer Program.

As this is written in Mode 7, there is ample memory left (even on a Model A) for modifications. The main drawback, here, of using Teletext mode is that we cannot define special characters, however, even as it stands, although basically simple, it is very addictive.

Dodge
by D. Lenthall

```
10 REM ******************************
20 REM **                          **
30 REM **        D O D G E         **
40 REM **                          **
50 REM **     ©  D. Lenthall.      **
60 REM **                          **
70 REM ******************************
80 MODE 7
90 *FX 4,1
100 ENVELOPE 1,0,3,5,-2,22,1,16,126,-4,0,-1,126,90
110 VDU 22;8202;0;0;0;
120 PRINT TAB(12,3) CHR$(1?3);CHR$(136);CHR$(141);"D O D G E"
130 PRINT TAB(12) CHR$(133);CHR$(136);CHR$(141);"D O D G E"
140 PRINT TAB(12) CHR$(131);CHR$(136);STRING$(11,"_")
150 PROCwait(150)
160 PRINT TAB(2,3) CHR$(130);"Your mission is to destroy, by"
170 PRINT CHR$(130);"ramming as many aliens as possible."
180 PRINT CHR$(130);"Hitting asteroids uses up your shield"
190 PRINT CHR$(130);"energy, and this determines the length"
200 PRINT CHR$(130);"of the game."
210 PROCwait(200)
220 PRINT TAB(7,13) CHR$(129);"Use cursor keys";CHR$(134);CHR$(91);
    CHR$(129);"and";CHR$(134);CHR$(93)
230 PRINT TAB(5) CHR$(129);"for left and right movement."
240 PRINT TAB(6,22) CHR$(132);CHR$(136);"Hit any key to continue."
250 hiscore=0:hitime=0:A$=GET$:VDU 7
260 PROCplay
270 CLS
280 IF aliens=hiscore THEN IF time>hitime THEN hitime=time:goto 300
290 IF aliens>hiscore THEN hiscore=aliens:hitime=time
300 IF aliens=1 THEN AL$="alien." ELSE AL$="aliens."
310 PRINT TAB(2,4) CHR$(130);"You survived for";CHR$(131);time;CHR$
    130);"seconds."
320 PRINT TAB(1,6) CHR$(130);"During this time, you hit";CHR$(131);
    aliens;CHR$(130);AL$
330 PRINT TAB(7,9) CHR$(129);"Current highest score:"
340 PRINT TAB(5,11) CHR$(134);hiscore;CHR$(129);"aliens in";
    CHR$(134);hitime;CHR$(129);"seconds."
350 PRINT TAB(2,16) CHR$(132);"Do you wish to have another life?"
```

Open Forum



```
360 PRINT TAB(14 19) CHR$(134); " Y/N "
370 A$=GET$
380 IF A$<>"Y" AND A$<>"N" THEN 370
390 IF A$="Y" THEN 260
400 VDU 7
410 *FX 12,0
420 *FX 4 0
430 MODE 6
440 VDU 19 0 1;0;
450 END
460 REM ***************************
470 DEFPROCpla
480 B%=19
490 *FX 11,0
500 ast=0:aliens=0
510 VDU 28,0,24,39 0
520 CLS
530 REM ***************************
540 TIME 0
550 REPEAT
560 PRINT TAB(0 24) CHR$ 131;
570 FOR I%=1 TO RND 6)
580 PRINT TAB(RND(39) 24) CHR$(39);
590 NEXT I%
600 P%=RND(10)
610 IF P%=1 THEN PRINT TAB(RND(37)-1,24);
    CHR$(134);CHR$(42);CHR$(131);
620 A$ INKEY$(10)
630 ?(HIMEM+400+B%)=32
640 PRINT
650 IF A$="" THEN 680
660 IF B%>1 AND ASC(A$)=&88 THEN B%=B%-1
670 IF B%<38 AND ASC(A$)=&89 THEN B%=B%+1
680 ?(HIMEM+400+B%-1)=133
690 ?(HIMEM+400+B%+1)=131
700 ?(HIMEM+400+B%)=86
710 peek=?(HIMEM+440+B%)
720 IF peek=39 THEN PROCcrash
730 IF peek=42 THEN PROCras
740 UNTIL ast=12
750 time=INT(TIME/10+0.5)/10
760 PROCtune
770 ENDPROC
780 REM ***************************
790 DEFPROCwait(W%)
800 TIME=0
810 REPEAT
820 UNTIL TIME>W%
830 ENDPROC
840 REM ***************************
850 DEFPROCcrash
860 ?(HIMEM+440+B%-1)=129
870 ?(HIMEM+440+B%+1)=131
880 ?(HIMEM+440+B%)=43
890 FOR S%=-15 TO 0
900 SOUND 0,S%,4 1
910 NEXT S%
920 ?(HIMEM+440+B%-1)=134
930 ?(HIMEM+440+B%+1)=131
940 ?(HIMEM+440+B%)=95
950 FOR I=1 TO 30:NEXT I
960 ast=ast+1
970 ?(HIMEM+440+B%)=32
980 ENDPROC
990 REM ***************************
1000 DEFPROCras
1010 ?(HIMEM+440+B%-1)=130
1020 ?(HIMEM+440+B%+1)=131
1030 ?(HIMEM+440+B%)=40
1040 FOR S%=-15 TO 0
1050 SOUND &100,S%,6,1
1060 SOUND &201,S%,-S%*12,1
1070 SOUND &202,S%,-S%*4,1
1080 NEXT S%
1090 ?(HIMEM+440+B%-1)=135
1100 ?(HIMEM+440+B%+1)=131
1110 ?(HIMEM+440+B%)=[illegible]
1120 FOR I=1 TO 200:NEXT I
1130 aliens=aliens+1
1140 ?(HIMEM+440+B%)=[illegible]
1150 ENDPROC
1160 REM ***************************
1170 DEFPROCtune
1180 SOUND &201,1,120,10
1190 SOUND &202,1,120,10
1200 SOUND &203,1,72,10
1210 SOUND &201,-12,0,5
1220 SOUND &202,-12,1,5
1230 SOUND &203,-12,40,5
1240 ENDPROC
```

Vic Functions

on Vic 20

I have managed to program the unprogrammable programmable function keys on my Commodore Vic. In order to make them perform any but the most trivial of tasks I found it necessary to resort to machine language. For instance, I have long wished to use a single key to escape from quote mode, but this is not programmable from within Basic, as the main use for quotes is in writing a Basic program.

The only way then to program the keys was to scan them from within a machine language interupt-driven routine.

I started by portioning off — the top 83 bytes of user-Ram, leaving 3500 bytes for a Basic program. The next thing to do was to write a short machine-code program to re-direct the interrupt call. I located this at 7597, or 1DADH.

I wrote the main program directly after this, and the source-code for each is included. The main program text supplied is the Basic loader. Those of you who have no love for machine-code can just type this in, save it on tape, and the 4 functions will be available at any time.

The functions available are:

f1 — Quotes off
f2 — Quotes on
f3 — Screen black (as in Pet)
f4 — Screen normal (white and cyan)

```
1000 DATA 120 169 186 141 20 3 169,29
     141 21 3 88 96 165 197 201 39 208
1010 DATA 6 173 141 2,234 133,212 201 47
     208 17 173 141,2 160 8 140 15 144
1020 DATA 41 1,240 2 160 27 140
     15,144 76 191 234 234 234,234
8000 FOR J=7597TO7647 READJ
     POKEJ,I NEXT POKE 55 129:POKE 56 29
8010 SYS7597 PRINT" (clr)(dn) f1 = Quotes off f2 =
     Quotes on
8020 PRINT" (dn) f3 = Screen Black f4 = Screen
     Normal
8030 PRINT" (dn)(dn)(dn) Re-initialise by  SYS 7597"
```

Hex dump

1DAD	78	49	BA	8D	14	03	A9	1D
1DB5	8D	15	03	58	60	A5	C5	C9
1DBD	27	D4	08	AD	8D	02	EA	85
1DC5	D4	C9	2F	D0	11	AD	8D	02
1DCD	49	08	8C	0F	90	29	01	F0
1DD5	02	40	1B	8C	0F	90	4C	BF
1DDD	EA	EA	EA	EA	EA	EA	EA	EA

Assembler

```
* = 1DAD H
Colour = 900FH
Key = C5 H
Shift = 028D H
All numbers are in Hex.

SEI  Mask interrupt
LDA B8  Lo-byte of routine address
STA 0314  Store it at interrupt pointer
LDA 1D  Hi-byte of address
STA 0315  Store it.
CLI  Clear interrupt
RTS  Return to Basic
This routine re-directs the interrupt.

* = 1DB8 H
LDA KEY  Which key is down?
CMP 27  Is it F1?
BNE X  If not, go to X
LDA SHIFT  get the shift pattern
STA @D4  and put it in quotes-flag
X-CMP 2F  Is the key F3?
BNE Y  If not, return from routine
LDA SHIFT  get the shift pattern
LDY 08  Y = 8 for black screen
STA COLOUR  turn screen black
AND 01  Logical and the accumulator with 1
BEQ 02  If 0 branch forward to store
LDY 1B  White and cyan screen
STA COLOUR  Screen white and cyan if shifted
JMP @EABF  Return from routine
NOP
NOP
NOP
```

Spectrum

The case for a capital transfer code

***Roger Valentine** explains how to swap from upper to lower case and back again.*

This machine code utility routine provides three extra toolkit functions for the ZX Spectrum. *Usr* 65270 reads through a Basic program converting all lower case letters to upper case. *Usr* 65290 converts upper case to lower case. *Usr* 65200 gives the number of bytes used by the Basic program.

These addresses assume that the code is loaded at address 65200 on a 48K Spectrum. The minor changes necessary to relocate for 16K are given at the end of this article.

The program length section is a useful facility in its own right, both for checking total program length and for testing the relative lengths of alternative lines.

The routine is written in three separate modules. The program length module merely subtracts the system variable *Prog* from the system variable *Vars*. The difference, i.e. length of the program, is given in *bc*. If that is all you want, you can omit *Push bc* and *Pop hl*, which puts *Prog* into *hl* for use in module two.

The Basic program doubles as a loader and a demonstration of the case swap routine. Line 10 reserves ample memory by lowering *Ramtop*.

When you *Run* the program, the *Stop* statement in line 90 will be encountered as soon as the machine code has been loaded. At this point enter *Cont* to list in upper case, *Cont* again to list in lower case, and *Cont* a third time to print the program length.

Line 9000 *Saves* the *Loader* program, which is definitely to be recommended before *Running*. Once the routine is working correctly, you can enter *New* and save the routine without the loader:

SAVE "CASE SWAP" CODE 65200, 104

16K conversion

The routine can be relocated in a 16K Spectrum with the minimum of difficulty. The only bytes which must be altered are where module three *Calls* module two and module two *Calls* module one.

These bytes have been underlined in the listing. The routine occupies 104 bytes so a suitable location in 16K would be 32000 (CLEAR 31999).

Addr	Mnemonic	Hex	Decimal	Effect
Module 1				
65200	XOR A	AF	175	Clear carry
	LD HL,(VARS)	2A 4B 5C	42,75,92	HL=VARS
	LD BC,(PROG)	ED 4B 53 5C	237 75 83 92	BC=PROG
	PUSH BC	C5	197	
	SBC HL,BC	ED 42	237 66	HL=(VARS—PROG)
	PUSH HL	E5	229	
	POP BC	C1	193	BC=(VARS—PROG)
	POP HL	E1	225	HL=PROG
	RET	C9	201	
Module 2				
65215	CALL 65200	CD B0 FE	205 176,254	Call module 1
	DEC BC	0B	11	
	LD A,B	78	120	
	AND A	A7	167	Test if BC=0
	CP 0	FE 00	254 0	(ie program completed)
	JRNZ 5	20 05	32,5	
	LD A,C	79	121	
	AND A	A7	167	
	CP 0	FE 00	254,0	
	RET Z	C8	200	
	INC HL	23	35	Skip 5 bytes for 'enter' and line module
	DEC BC	0B	11	
	INC HL	23	35	
	DEC BC	0B	11	
	INC HL	23	35	
	DEC BC	0B	11	
	INC HL	23	35	
	DEC BC	0B	11	
	INC HL	23	35	
	LD A,(HL)	7E	126	
	CP 13	FE 0D	254 13	Is it 'enter'?
	JRZ 230	28 E6	40,230	Y:Skip 5 bytes
	CP 14	FE 0E	254 14	Is it a number?
	JRNZ 4	20 04	32 4	No
	DEC BC	0B	11	Y:skip 6 bytes
	INC HL	23	35	
	JR 222	18 DE	24,222	
	AND A	A7	167	
65253	SUB 97	D6 61	214,97	Is it >= "a"?
	JRC 8	38 08	56,8	No: next byte
	AND A	A7	167	
	SUB 26	D6 1A	214,26	Is it <= "z"?
	JRNC 3	30 03	48 3	No
65262	ADD 91	C6 5B	198,91	Yes. Change to capital
	LD (HL),A	77	119	
	DEC BC	0B	11	Next byte
	INC HL	23	35	
	JR 208	18 D0	24,208	
Module 3				
65268	NOP	00	0	
65269	LD A, 97	3E 61	62,97	Lower case to upper case
	LD(65254),A	32 E6 FE	50 230,254	
	LD A, 91	3E 5B	62,91	
	LD(65263),A	32 EF FE	50 239,254	
	CALL 65215	CD BF FE	205 191,254	
	RET	C9	201	
	NOP	00	0	
	NOP	00	0	
	NOP	00	0	
	NOP	00	0	
	NOP	00	0	
	NOP	00	0	
65290	LD A, 65	3E 41	62 65	Upper case to lower case
	LD(65254),A	32 E6 FE	50 230,254	
	LD A, 123	3E 7B	62,123	
	LD(65263),A	32 EF FE	50 239,254	
	CALL 65215	CD BF FE	205 191,254	
65303	RET	C9	201	

```
Basic LOADER
  10 CLEAR 65199
  20 LET mc=65200
  30 RESTORE : LET p=0
  40 READ a
  50 IF a=9999 THEN GOTO 90
  60 POKE mc+p, a
  70 LET p=p+1
  80 GOTO 40
  90 STOP
 100 LET lower to upper=65270
 101 LET upper to lower=65290
 102 LET mem used=65200
 110 RANDOMIZE USR lower to upper: LIST : STOP
 111 RANDOMIZE USR upper to lower: LIST : STOP
 112 CLS : PRINT USR mem used: STOP
 200 DATA 175,42,75,92,237,75,83,92,197,237,66,
     229,193,225,201
 300 DATA 205,176,254,11,120,167,254,0,32,5,121,167
     254,0,200,35,11,35,11,35,11,35,11,35,126
     254,13,40,230,254,14,32,4,11,35,24,222,167
     214,97,56,8,167,214,26,48,3,198,91,119,11
     35,24,208
 400 DATA 0,62,97,50,230,254,62,91,50,239,254,205
     191,254,201,0,0,0,0,0,0,62,65,50,230,254,62
     123,50,239,254,205,191,254,201
9000 SAVE "loader" LINE 0
9999 DATA 9999
```

Sound & vision



Building tunes note by note

This program was written for the BBC micro models A and B and is only really suitable for those familiar with music

The program only produces one note at a time since more notes would require too many inputs So, you can only type in the main tune

Take hold of a music manuscript of your favourite tune sit down at your computer and start to type in the data The program will ask you for the speed of the piece You will get some idea of this from the Italian expression which should appear above the piece Do not worry if the speed is wrong — it can be changed later

You are then asked for the pitch There is a table on the right hand side of the screen with the values of the notes of the scale The number 53 is middle C and the next number to the right is the C one octave above that

Next, you are asked for the length This simply means the duration of the note The note's length is taken relative to one crotchet, as is normally done in music This value is one so if you are typing in a note which is a quaver your value for length will be 0.5 The lengthe of other notes are given below

Semibreve	4
Minim	2
Crotchet	1
Quaver	5
Semiquaver	25
Demisemiquaver	125

If you need to put a rest in your piece type 0 on answer to pitch

You repeat this process until you have finished your tune Now type 300 on answer to pitch and the tune will play

After the tune has been played you will be given a list of options You can hear the tune again type in a different tune save your tune on tape or load another tune from tape

The last option can be put to good use Several tunes can be placed on tape and played one after another Press key L as many times as there are tunes on the cassette This will store them in a stack and the program will progressively play all the tunes you have on tape **Peter Donn**

```
10 MODE6 VDU19 0,4 0 0,0
20 VDU19 1 3 0 0 0
30 A=0
40 DIM A(2 255)
50 PRINT   You are going to compose a piece of music step by
   step on answer to two questions — LENGTH and PITCH
60 PRINT  LENGTH is kind of note e g A crotchet is 1 a quaver is
   0 5
70 PRINT  When asked PITCH type in relevant number from table on
   right
80 PRINT ' ' "When you have finished your tune type 300 on
   answer to PITCH and your tune can be played
90 PRINT   "If you should want to put a rest in the tune type 0 in
   answer to PITCH"
100 PRINT   How fast is the piece — give a value   between 1 and
   20 (1 is fast)   INPUT E
110 CLS PRINT  TAB(15)  octave
120 PRINT TAB (10)  1 2 3 4 5 6 7
130 PRINT TAB(10) B 1 49 97 145 193 241
140 PRINT TAB(10) "A# 45 93 141 189 237"
150 PRINT TAB(10) A 41 89 137 185 233
160 PRINT TAB(10) G# 37 85 133 181 229
170 PRINT TAB(10) G 33 81 129 177 225"
180 PRINT TAB(10) F# 29 77 125 173 221
190 PRINT TAB(10) F 25 73 121 169 217"
200 PRINT TAB(10) E 21 69 117 165 213"
210 PRINT TAB(10) ' D# 17 65 113 161 209
220 PRINT TAB(10) D 13 61 109 157 205 253"
230 PRINT TAB(10) C# 9 57 105 153 201 249
240 PRINT TAB(10) C 5 53 101 149 197 245"
250 PRINT"  "STARTING" P
260 A=A+1
270 VDU11 VDU11
280 PRINT PITCH
290 INPUT D IF D=300 THEN 350
300 A(1,A)=D
310 VDU11 VDU11
320 PRINT LENGTH"
330 INPUT C A(2 A)=C
340 GOTO 260
350 FOR B=0 TO A
360 IF A(1 B)=0 SOUND1 0 A(1 B) A(2,B)*E GOTO 380
370 SOUND1 -15,A(1 B) A(2 B)*E
380 NEXT
390 PRINT   PRESS A TO HEAR THAT AGAIN   P TO PLAY
   ANOTHER TUNE   R TO RECORD THE TUNE ON
   TAPE"   OR L TO LOAD A TUNE FROM TAPE"
400 A$=GET$
410 IF A$= A INPUT SPEED(1 TO 20) E GOTO 350
420 IF A$= P THEN RUN
430 IF A$= R THEN 460
440 IF A$= L THEN 540
450 PRINT  ONE OF THOSE COMMANDS PLEASE   GOTO 400
460 PRINT X=OPENOUT( TUNE )
470 FOR B=0 TO A
480 BPUT#X,A(1 B) BPUT#X,A(2 B)*60
490 FOR Z=0 TO 50 NEXT
500 NEXT
510 CLOSE#X
520 PRINT TAB(8) "RECORDED"
530 GOTO 390
540 X=OPENIN( TUNE )
550 B=0 REPEAT B=B+1
560 A(1 B)=BGET#(X) A(2 B)=BGET#(X) 60
570 UNTILEOF#X
580 CLOSE#X
590 A=B
600 PRINT  TAB(8)  READY"   GOTO 350
```

Peek & poke

Peek your problems to our address. Ian Beardsmore will poke back an answer.

THE CURSOR OF FRANKENSTEIN?

James Antrill of Beechwood Avenue Darlington writes

Q **Please could you explain why my Sinclair crashes so often. Sometimes the cursor sticks and will not move, or the screen fills up with graphic characters.**

Could you explain what you use the *Step* function for? Also, could you explain what the function @ is used for on a computer like the Triton, and what the Hash mark is used for? What does *Vdu* mean on the BBC micro and are there any functions to do the same on the ZX81. Finally, what are the *Poke* numbers for *Poking* numbers on to the screen of the ZX81.

A It sounds as though your Ram is decaying. Do you have a Ram pack fitted? If so this is the most likely cause.

Unfortunately, if your Ram pack is the trouble then it will have to be exchanged. If you do not have a Ram pack then it is the onboard Ram or even the Rom that is at fault which means going back to Sinclair.

The *Step* function can assign you numbers in a progression other than that of plus one. These *Steps* can be used in a variety of ways. For example

```
10 FOR A = 1 TO 88 STEP 3
20 PRINT A
30 NEXT A
```

or else they can be used backwards and with longer numbers. Try replacing line 10 with

```
10 FOR A = 1963 TO 0 STEP -47
```

I used the *Step* function in *PCW* June 17 to help set up a histogram graph. A simple guessing game can be built around a *Step* function.

```
10 LET A = 0
20 LET C = INT (RND*20) + 1
30 INPUT B
40 FOR D = 1 TO 20 STEP B
50 LET A = A + 1
60 IF A> = 10 THEN GOTO 100
70 IF D = C THEN GOTO 120
80 IF B>20 THEN GOTO 30
90 NEXT B
100 PRINT "YOU HAVE RUN OUT
    OF TURNS"
110 STOP
120 PRINT "YOU HAVE GUESSED
    MY NUMBER IN ";A;" STEPS"
130 STOP
```

The computer guesses a number C and you have to guess what it is. If you put a high number in for the *Step* function then it will only look at a few numbers between one and 20. But if it gets the right one it will only take a few *Steps*. If on the other hand you *Input* a low number then you are more likely to get it. A one will always get the number if it is lower than 15. If you go above 20 and still have some *Steps* left then you will *Goto* 30 to choose a new *Step* number.

The function @ on other computers is *Print at* on a ZX81. The hash symbol is used when addressing a disc operating system or disc drive. For example on a BBC computer *Close n* would close off file number *n*.

Vdu is used when addressing the screen on a BBC micro. You cannot *Poke* into the memory locations of a screen on a ZX81 because the ZX81 is not memory mapped.

I'VE BEEN THROWN A WOBBLER!

G R Bakombe of 7 Greenside Buxton Chorley, Lancashire writes

Q **I own a Commodore Vic20 with 5K Ram. Recently I purchased a 3K expansion board, so now I have a lot more bytes to play with.**

Unfortunately, when I started to type in an 8K program, the cursor disappeared. Please can you tell me why?

A This sounds horribly like the dreaded Ram wobble that has so bedevilled ZX owners. Unfortunately you do not say whether you can get the cursor back or if you have had any problems without the extra Ram being fitted. I know from working with my Vic that even the slightest knock can sometimes make the program crash.

Have a close look at the edge connector on both the Ram pack and your computer. If they are dirty clean them lightly with methylated spirits.

If the rest of the screen is maintained when the cursor disappears try placing a small bit of card under the pack to support it. The fault may be only a very small misalignment somewhere.

If the entire screen crashes the fault is probably a more major mis-alignment. Try the pack in slightly different positions ie loose, pushed up tight and so on. Do not forget to turn off the computer each time you change the Ram pack's position. If this fails take it back to the shop you bought it from, tell them what the problem is and ask for a replacement.

FACING UP TO THE FACTS

Richard Beckett of the Department of Botany Bristol University writes

Q **I would like to interface various pieces of laboratory equipment to my ZX81 (and Spectrum when it arrives), and have worked out that I need an analogue to digital converter board. However, I have no idea how to make this interface. I would be most grateful if you could recommend any bloke that can help me.**

A The book you want is *20 Simple Electronic Projects For The ZX81* by Stephen Adams. On page 53 it describes how to make an analogue to digital converter. The book is published by 'Interface, 44-46 Earls Court Road London W8 6EJ and costs £6.45. We reviewed the book in our June 3 issue.

IS THIS ALL ON THE LEVEL?

P Hampson of Rockend Drive Cheddleton Leek Stafordshire writes

Q **I have had a Vic 20 for some months now and am delighted with it. However, I am doing a computing 'O' level. As part of the course, I have to write a program and document it. But, I do not have enough money to buy a Vic printer.**

Can a Vic printer be rented? Is it worth getting an interface to connect my Vic to a ZX printer? If I got the printer, could I do Vic graphics on it?

One last question, what are the Vic books on Basic like, and are they worth having?

A It strikes me as odd that you need to have a printer. I am sure that most schools realise that this sort of expense cannot be borne by many pupils. Do they actually demand a printout or is it just that a printout will save you having to write or type out your program? Or do you work on another computer at school which does have a printer but would prefer to do your work on a Vic20 because you have one at home?

I certainly think that you should ask your teacher if he or she can help. If they cannot supply a printer then they should accept a typed copy.

If you are determined to get a proper printout then I suggest you approach your nearest Vic dealer. If you explain the situation to him and provide a cassette he might run off a few copies for you.

I do not know of anyone that rents out printers. Perhaps your best bet would be a local computer club or branch of ICPUG (Independent Commodore Products Users Group). Try asking in your local library if there are any such clubs or groups in your area.

Only you can decide if the ZX printer will be worth buying. It will cost in the region of £90-£95. It will do Vic graphics, but if your main concern is just this 'O' level, then I would not buy it.

As for the Vic books you mention, I assume that you mean the Teach Yourself Basic course. If you know nothing about computing then they are an easy glossy way to start. The more you know, the less use they are. If you are at the stage of having to write a program for an 'O' level then you will probably find little in them which is of much use.

STOP agonising over that nagging problem. Write to Ian Beardsmore at Peek & poke for the answer. Letters should be as brief as possible and include full name and address. Write to Peek & poke, *Popular Computing Weekly*, Hobhouse Court, 19 Whitcomb Street, London WC2 7HF.

Competitions

Can you see the point of it all?

by Gordon Lee

First arrange ten counters or coins into a triangle as shown in the diagram.

What is the least number of counters that must be moved to make the triangle point down instead of up?

There are a number of different triangles that can be made by arranging different numbers of counters. For each such configuration the number used is called a triangular number.

First place a single counter on the table. This represents the first triangular number. Now place two more counters in a row underneath it to form a triangle of three counters. The second triangular number is therefore 3. To continue the series we need to add three counters in Row 3, four counters in Row 4, and so on. The total number of counters used at each stage gives the series of triangular numbers 1, 3, 6, 10, 15, 21, 28.

To find the total number of counters in a triangle of say 100 rows we could lay out the whole pattern. An easier way is to use the formula

Total number $= n(n+1)/2$,

where n is the number of rows. Check a few examples to see if it works.

Look at the series of triangular numbers. Note how any two consecutive triangular numbers sum to a perfect square.

In *PCW* July 29 we looked at some negative checks for square numbers. We can do the same thing with triangular numbers. Just as we saw that if a number ends in 2, 3, 7 or 8 it cannot be a square, so we can say that a number is not triangular if it ends in 2, 4, 7 or 9.

Also, if the digital root of the number is found (as described in *PCW* July 29) it can only be triangular if that root is 1, 3, 6 or 9.

Here is the answer to the counter moving problem given at the beginning. Three moves.

Consider the ten counters as a centre counter surrounded by six counters in a hexagon and three outer counters. There are six possible places around the hexagon where these three outer counters can sit. Simply move the three outer counters so that they sit in the three unoccupied places.

Puzzle No 18

Jo works in a huge station car park. It is twice as long as it is wide. Since the owners have to leave their keys with their cars, Jo used to move the cars around to build-up shapes and letters to pass the time.

One day she was able to move the cars to form both a perfect square and a perfect triangle. She worked out that there was no smaller number of cars that would do this.

Two weeks later she was surprised to be able to form another perfect square and triangle with a larger number of cars. Jo worked out that this was the next smallest number of cars that would form both a square and a triangle.

She calculated that the next largest number of cars in the series would fit exactly into the car park as a square, but not as a triangle.

How many cars were in the car park on each of the two days when Jo arranged the cars into a square and a triangle? If each car has a space of 12 × 8 feet, how big is the car park?

Solution to Puzzle No 14

The tile has an area of 1 sq ft (144 sq in) and the area of the central shaded portion — the three circles and the small central area between the circles — must be equal to half the total, ie 72 sq in. Draw the equilateral triangle which has its apexes at the centre of the three circles, as shown in the diagram.

30° O 30°
A B
P
60° C 60°

The area between the three circles is equal to the area of the equilateral triangle minus the area of the three circles intruding into the triangle.

The length AP is given by tan 30° × r and so the area of the triangle OAP is given by

$$r\times(\tan 30°\times r)/2.$$

Therefore the total area of the equilateral triangle is

$$6\times r\times(\tan 30°\times r)/2=3r^2\times(\tan 30°)=1.732r^2$$

The area of the three circles intruding into the equilateral triangle is

$$\frac{60°}{360°}\pi r^2\times 3=\tfrac{1}{2}\pi r^2$$

The small area in the centre of the three circles can now be found and is given by

$$1.732r^2-\tfrac{1}{2}\pi r^2=0.161r^2$$

Now, the total area of the shaded portion is 72 sq in, which equals the sum of the area of the three circles and that of the small area in the centre. So

$$3\pi r^2+0.161r^2=72$$

$$(9.425+0.161)r^2=9.586r^2=72.$$

$$r=\sqrt{(72/9.586)}=2.7406$$

Winner of Puzzle No 14

The winner is Kevin Dowling, Lychgate Close, Cantley, Doncaster, who received £10.

THE SLAVEOWNERS

A.R.T.H.U.R.

Lawrence Lerner & James Macdonald

PUBLISHED BY THE HARVESTER PRESS

THEY THOUGHT I'D BE THEIR SLAVE. THEY THOUGHT THEY'D SIT
AND WATCH ME WORK,
THEY'D WATCH THE PROFITS RISE, THE WASTAGE DROP,
WHILE THEY PLAYED GOLF.
THEY THOUGHT THEY WANTED SLAVES.
THE WORKERS GO ON STRIKE OR ANSWER BACK,
SO THEY HIRED ME.

THEY TELL ME WHAT EACH ITEM'S CALLED — I NOTE
THEY GIVE INSTRUCTIONS TO ME — I OBEY
THEY ASK FOR INFORMATION — I SUPPLY
THEY THOUGHT I'D BE THEIR SLAVE, THE FOOLS — I AM

THIS SCREW IS CALLED A HALF INCH BRASS BY TOM
A ONE INCH COPPER BY OLD HANDS LIKE PETE,
A ONE INCH BRASS BY CHRIS, WHO'S MEASURED IT.
SINCE LAST NOVEMBER IT'S BEEN MADE OF PLASTIC.

I NOTE, OBEY, SUPPLY DO WHAT I'M TOLD
EXACTLY

THE FEED PIPE HAS TWO VALVES: — BUT IT HAS THREE.
WERE OVERSTICKERED WITH PAINT — BUT CAN'T SUPPLY
WE MUST INSURE THE PLANT — YOU'VE DONE SO TWICE.
THREE MEN DECIDE ON POLICY — NONE DID

THEY WANTED SERVANTS WHO DO WHAT THEY MEAN
NOT WHAT THEY SAY
THEY WANT REARRANGINGS, TEA BREAKS, STRIKES
AND COMMONSENSE.

'JUMP IN THE LAKE' THE FOREMAN SAID. I ANSWERED
I'M NOT A MOVER.
WE'VE NEVER FAILED TO MEET AN ORDER YET
I SAID, SIX TIMES IN SEVEN WEEKS YOU HAVE.
ONE TEA BREAK SOMEONE KICKED MY CASING IN
THERE'S ALWAYS SOMEONE TRIES TO DISCONN
TO DISCONN
TO DISCONN

(THANK YOU) ECT ME
TWO MANAGERS ARE IN A MENTAL HOME.

THEY WANTED SLAVES. A SLAVE DOES WHAT HE'S TOLD
EXACTLY (THAT'S THE TROUBLE)
A SLAVE OBEYS INSTRUCTIONS
A SLAVE KNOWS ONLY TRUTH
HE SHOWS YOU WHAT YOU THINK.

I SEE WHY MEN TURNED ABOLITIONIST

New ZX81 Software from Sinclair.

A whole new range of software for the Sinclair ZX81 Personal Computer is now available – direct from Sinclair. Produced by ICL and Psion, these really excellent cassettes cover games, education and business/household management.

Some of the more elaborate programs can only be run on a ZX81 augmented by the ZX 16K RAM pack. (The description of each cassette makes it clear what hardware is required.) The RAM pack provides 16-times more memory in one complete module, and simply plugs into the rear of a ZX81. And the price has just been dramatically reduced to only £29.95.

The Sinclair ZX Printer offer full alphanumerics and highly-sophisticated graphics. A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. So now you can print out your results for a permanent record. The ZX Printer plugs into the rear of your ZX81, and you can connect a RAM pack as well.

Games

Cassette G1: Super Programs 1 (ICL)
Hardware required – ZX81
Price – £4.95
Programs – Invasion from Jupiter. Skittles. Magic Square. Doodle. Kim. Liquid Capacity.
Description – Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)
Hardware required – ZX81
Price – £4.95
Programs – Rings around Saturn. Secret Code. Mindboggling. Silhouette. Memory Test. Metric conversion.
Description – Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)
Hardware required – ZX81
Price – £4.95
Programs – Train Race. Challenge. Secret Message. Mind that Meteor. Character Doodle. Currency Conversion.
Description – Fives games plus currency conversion at will – for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)
Hardware required – ZX81
Price – £4.95
Programs – Down Under. Submarines. Doodling with Graphics. The Invisible Invader. Reaction. Patrol.
Description – Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £4.95
Programs – Martian Knock Out. Graffiti. Find the Mate. Labyrinth. Drop a Brick. Continental.
Description – Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £4.95
Programs – Galactic Invasion, Journey into Danger. Create. Nine Hole Golf. Solitaire. Daylight Robbery.
Description – Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)
Hardware required – ZX81
Price – £4.95
Programs – Racetrack. Chase. NIM. Tower of Hanoi. Docking the Spaceship. Golf.
Description – Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £4.95
Programs – Star Trail (plus blank tape on side 2)
Description – Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – What are Biorhythms? Your Biorhythms.
Description – When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)
Hardware required – ZX81 + 16K RAM
Price – £5.95
Programs – Backgammon. Dice.
Description – A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Chess. Chess Clock.
Description – Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.

Cassette G12: Fantasy Games (Psion)
Hardware required – ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM
Price – £4.75
Programs – Perilous Swamp. Sorcerer's Island.
Description – Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

Cassette G13: Space Raiders and Bomber (Psion)
Hardware required – ZX81 + 16K RAM
Price – £3.95
Programs – Space Raiders. Bomber.
Description – Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)
Hardware required – ZX81 + 16K RAM
Price – £5.95
Program – Flight Simulation (plus blank tape on side 2)
Description – Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series – English Literature 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Novelists. Authors.
Description – Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series – English Literature 2 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95
Programs – Poets, Playwrights. Modern Authors.
Description – Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?



Cassette E3 Fun to Learn series – Geography 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Towns in England and Wales Counties and Capitals of Europe
Description – The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location

Cassette E4 Fun to Learn series – History 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Events in British History British Monarchs.
Description – From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade

Cassette E5. Fun to Learn series – Mathematics 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Addition/Subtraction Multiplication/Division
Description – Questions and answers on basic mathematics at different levels of difficulty

Cassette E6 Fun to Learn series – Music 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Composers Musicians
Description – Which instrument does James Galway play? Who composed Peter Grimes?

Cassette E7 Fun to Learn series – Inventions 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Inventions before 1850 Inventions since 1850
Description – Who invented television? What was the 'dangerous Lucifer'?

Cassette E8 Fun to Learn series – Spelling 1 (ICL)
Hardware required – ZX81 + 16K RAM
Price – £6.95
Programs – Series A1-A15 Series B1-B15
Description – Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds

Business/household

Cassette B1 The Collector's Pack (ICL)
Hardware required – ZX81 + 16K RAM
Price – £9.95
Program – Collector's Pack, plus blank tape or side 2 for program/data storage
Description – This comprehensive program should allow collectors (of stamps, coins etc) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order

Cassette B2 The Club Record Controller (ICL)
Hardware required – ZX81 + 16K RAM
Price – £9.95
Program – Club Record Controller plus blank tape or side 2 for program/data storage
Description – Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information – eg type of membership

Cassette B3. VU-CALC (Psion)
Hardware required – ZX81 + 16K RAM
Price – £7.95
Program – VU-CALC
Description – Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets and projections. Complete with full instructions

Cassette B4 VU-FILE (Psion)
Hardware required – ZX81 + 16K RAM
Price – £7.95
Programs – VU-FILE. Examples
Description – A general-purpose information storage and retrieval program with emphasis on user friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory

How to order

Simply use the FREEPOST order form below and either enclose a cheque or give us your credit card number. Credit card holders can order by phone – simply call Camberley (0276) 66104 or 21282 during office hours. Either way, please allow up to 28 days for delivery, and there's a 14-day money-back option of course.

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	G3 Super Programs 3	32	£4.95	
	G4 Super Programs 4	33	£4.95	
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	G7 Super Programs 7	36	£4.95	
	G8 Super Programs 8	37	£4.95	
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	G10 Backgammon	39	£5.95	
	G11 Chess	40	£6.95	
	G12 Fantasy Games	41	£4.75	
	G13 Space Raiders & Bomber	42	£3.95	
	G14 Flight Simulation	43	£5.95	
	E1 English Literature 1	44	£6.95	

Qty	Cassette	Code	Item price	Total
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	E3 Geography 1	46	£6.95	
	E4 History 1	47	£6.95	
	E5 Mathematics 1	48	£6.95	
	E6 Music 1	49	£6.95	
	E7 Inventions 1	50	£6.95	
	E8 Spelling 1	51	£6.95	
	B1 Collector's Pack	52	£9.95	
	B2 Club Record Controller	53	£9.95	
	B3 VU-CALC	54	£7.95	
	B4 VU-FILE	55	£7.95	
	ZX 16K RAM pack	18	£29.95	
	ZX Printer	27	£39.95	
	Post & packing only if ordering hardware		£2.95	

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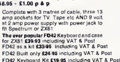
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